

Fuzing at Dahlgren

Mr. Michael Till

**NDIA 46th Annual Fuze Conference - April
30th, 2002**

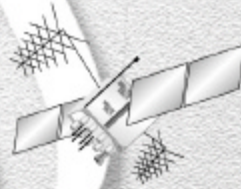
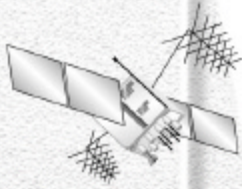
Naval Surface Warfare Center

DAHLGREN DIVISION

DAHLGREN LABORATORY

Naval Surface Fire Support

NAVAL SEA SYSTEMS COMMAND



NAVAL SURFACE WARFARE CENTER, DAHLGREN DIVISION

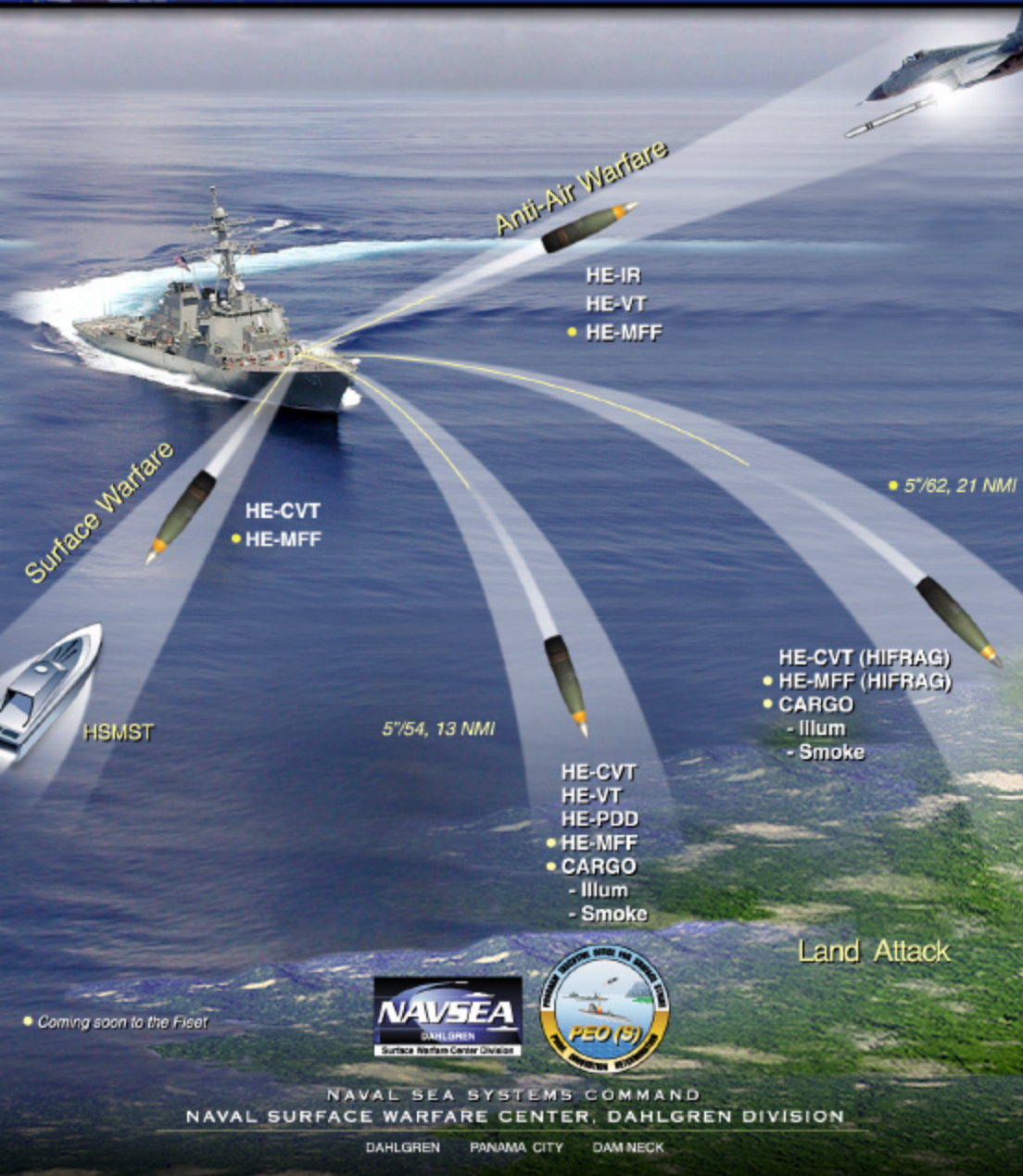
DAHLGREN PANAMA CITY DAM NECK

Conventional Ammunition

Guided Munitions

DEPARTMENT OF THE NAVY
UNITED STATES NAVY

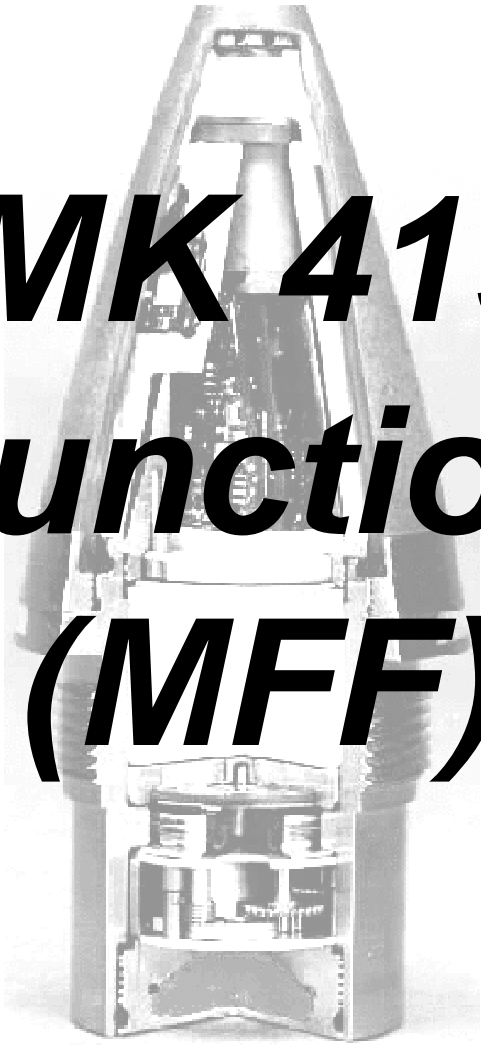
5-INCH CONVENTIONAL AMMUNITION



Fire Support

Surface Warfare

Air Warfare

A detailed cutaway view of the MK 419 Multi-function Fuze (MFF), showing its internal mechanical and electronic components. The fuze has a conical shape with a wide base and a narrow top. The internal structure includes a central cylindrical component, various electronic modules, and a base section with a complex internal mechanism.

MK 419

Multi-function Fuze

(MFF)



MFF Requirements

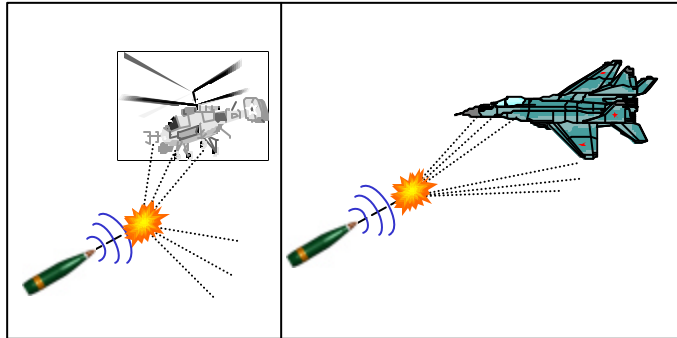
- Multi-function Fuze for USN 5" projectiles
- Standard NATO shape, weight and interface threads
- Compatible with 76mm, 105mm, 155mm and 16" projectiles
- 5 Operational Modes



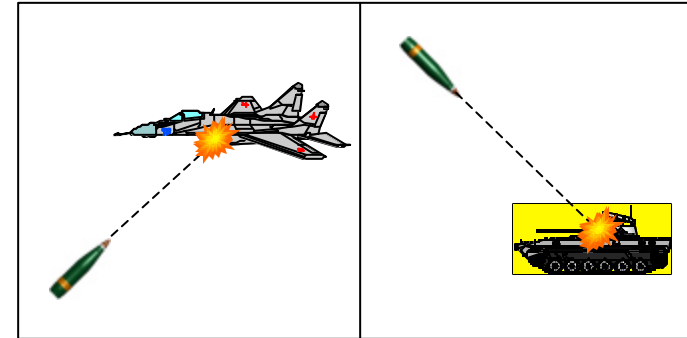


MFF Operational Modes

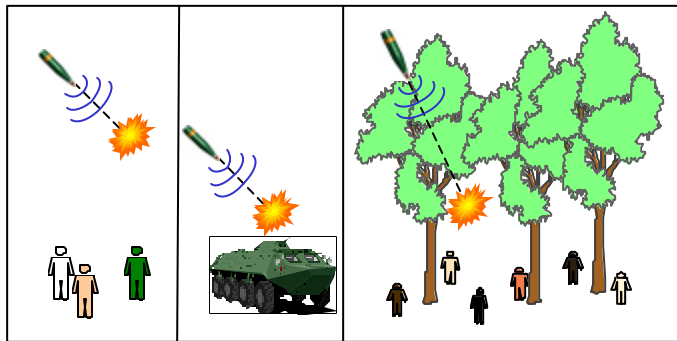
AIR



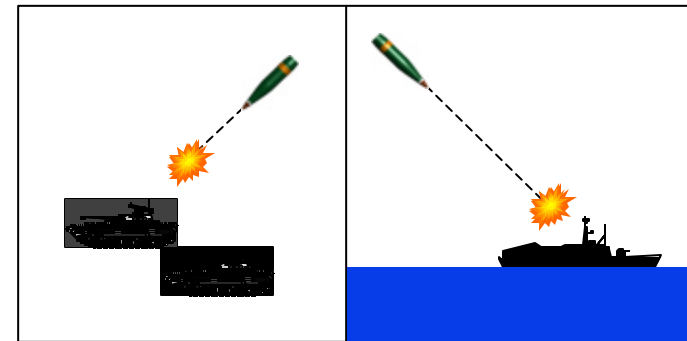
PD



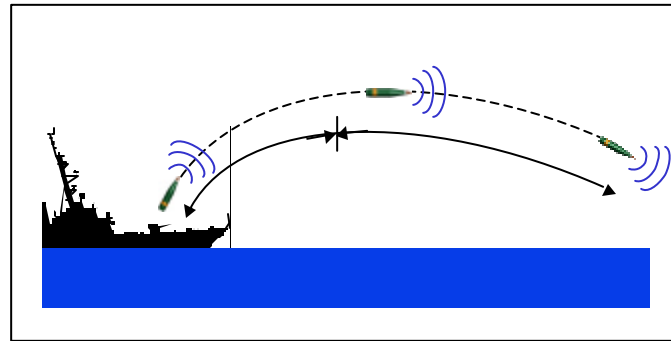
HOB



ET



AUTO



Replaces VT, CVT,
MT & PD fuzes on
HE rounds.
Simplifies logistics.
Uses IM Explosives.

Multiplies effectiveness
of ship's magazine.
Improves fuze
performance, accuracy,
reliability & versatility.



MFF Program Goals

- Primary Program Goals
 - Replace existing Variable Time, Mechanical Time, and Point Detonating fuzes with one fuze for 5-inch gun systems.
 - Decrease logistics burden ashore and afloat.
 - Provide increased insensitive munitions, overhead fire, and electromagnetic safety.
- Secondary Program Goals
 - Increase ordnance effectiveness.



Program Schedule

- Failure analysis recently completed
 - 2 stage doppler filter implemented to address sea clutter that causes AIR mode early bursts
 - Software solution adopted to address low HOB mode bias over land
 - Producibility changes will be implemented to eliminate arming failures that cause duds
- Developmental testing in FY02
- Operational testing in FY03
- IOC in FY04



M782 MOFA Qualification for the USMC

- US Marine Corp to Procure Army's M782 Multi-Option Fuze for Artillery (MOFA)
 - 105mm and 155mm Weapon Systems
 - No Changes Planned for the Fuze
- NSWC Dahlgren is Qualifying the M782 to the Unique USMC/USN Requirements
 - FY02 - Safety and Test Planning
 - FY03 - Testing and Conclusion



M782 MOFA Qualification for the USMC

Unique Test Requirements

- NAVSEA 9310 Lithium Battery Certification
- NAVSEA 8020.3a Lead Azide Instruction
 - Contained in Both M55 and M100 Dets
- MIL-STD-901D Shipboard Shock
- MIL-STD-464 Electromagnetic Effects



“Navalized” MOFA

- USN is seeking a low cost, multi-mission 5” projectile fuze
- A “Navalized” version of the Army’s M782 MOFA is an attractive alternative





What is “Navalization”?

- Compatibility with Gun Weapon System
 - Inductive Set Changes
- Increase Timer Precision?
 - High Speed Maneuvering Surface Target (HSMST)
- Increase Arming Distance?
 - MOFA Arms at ~200' in 5"/62
 - MFF Arms at ~1000' in 5"/62
 - Study to be Conducted to Determine Acceptable Safe Separation Distance



Compatibility with GWS

- Leverage Experience of Navalizing M762A1 into Navy's MK 432 MOD 0
- MOFA Inductive Coil Similar to M762A1
 - Replaced M762A1 Coil w/ MFF Coil
 - Similar Change Likely for Navalized MOFA
- Software Changes Necessary for Navy's 26-Bit Message Format



Increased Timer Precision

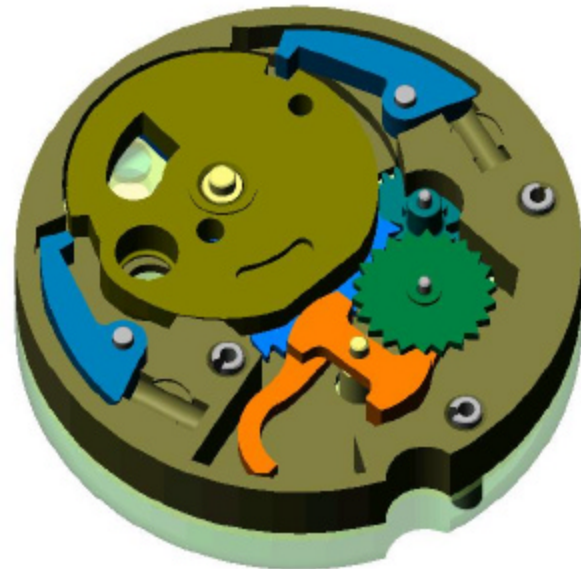
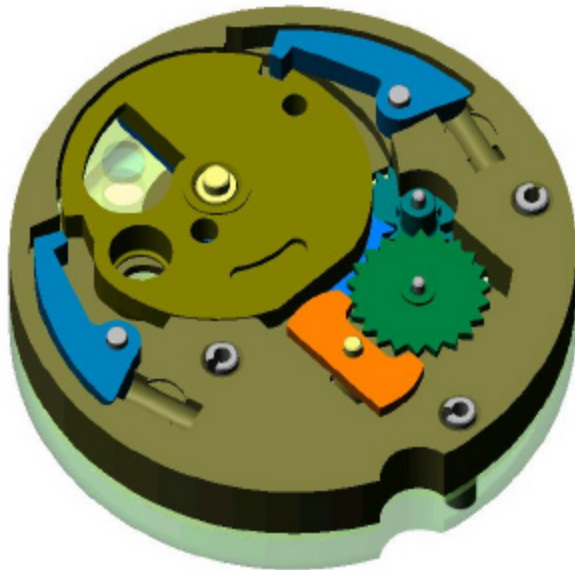
- MOFA is Settable in 0.1 Second Increments
 - Accuracy Dependent on Battery Rise Time
- Navy Desires to Engage Close In HSMST
 - Is the MOFA Timing Accuracy Sufficient?
 - Would Setting in 0.01 Second Increments Increase Effectiveness?
 - Study to be Conducted to Determine if Changes are Warranted



Potential Modifications for Safe Separation

Increase Arming Time by:

- Increasing pallet moment of inertia
- Adding rotor gear teeth
- Changing rotor CG





Notional “Navalized” MOFA Program Strategy

- Multi-Year effort commencing as early as 3rd Quarter FY02
- Maximize commonality with MOFA
 - Use the M762-MK432 paradigm
- Navy-Army-Industry Team
 - Competitive contract awarded for development, qualification and follow-on production



Projectile Fuze Analysis

- What 5" and 155mm Projectile-Fuze combinations will be operationally effective against present and future (2020) naval targets?
- Methodology
 - Identify targets and fuzes, present and future
 - Estimate number of fuzes required for equal effectiveness against each target
 - Determine best “powder mix”
 - Recommend acquisition approach: development, procurement and conversion (recapitalization)

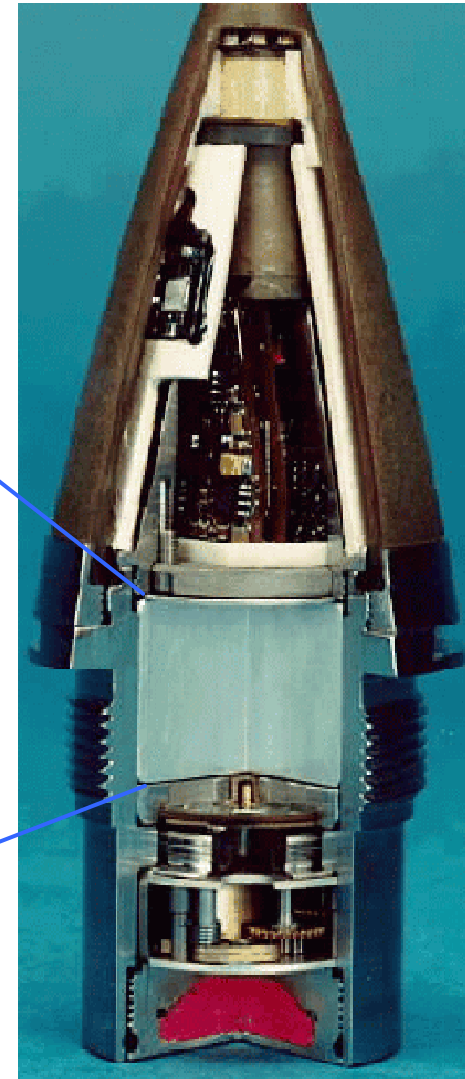
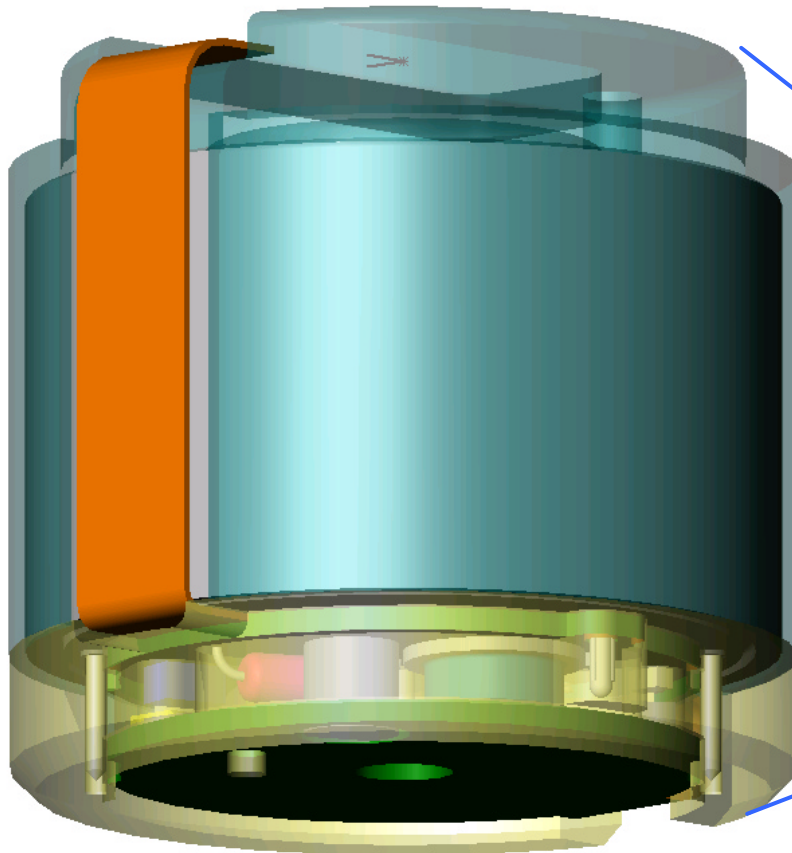
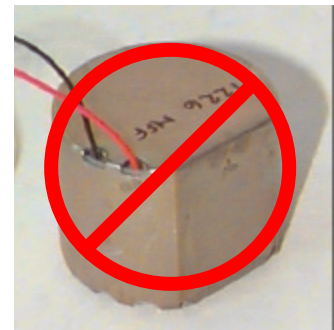


Projectile Fuze Analysis

- Conducted by Center for Naval Analysis (CNA)
 - Need for objectivity and independence
 - Completed in 2nd Quarter FY03
- Basis for future development programs
 - Course-corrected fuze
 - Guidance-integrated fuze



Development of a MOFA Battery Variant for MFF



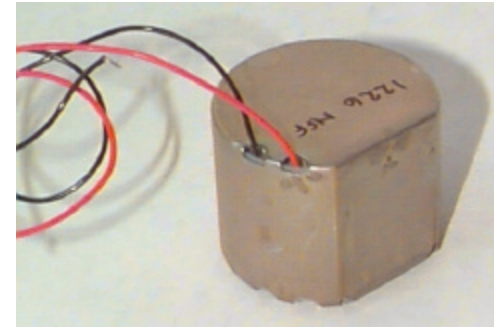


Projectile Fuze Batteries



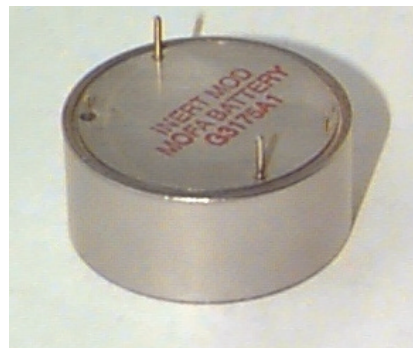
MK 43 MOD 0
MKs 404, 417 & 418
30 volts min

Lead-Acid;
very fast
rise time



MK 44 MOD 0
MFF
11.6 volts min

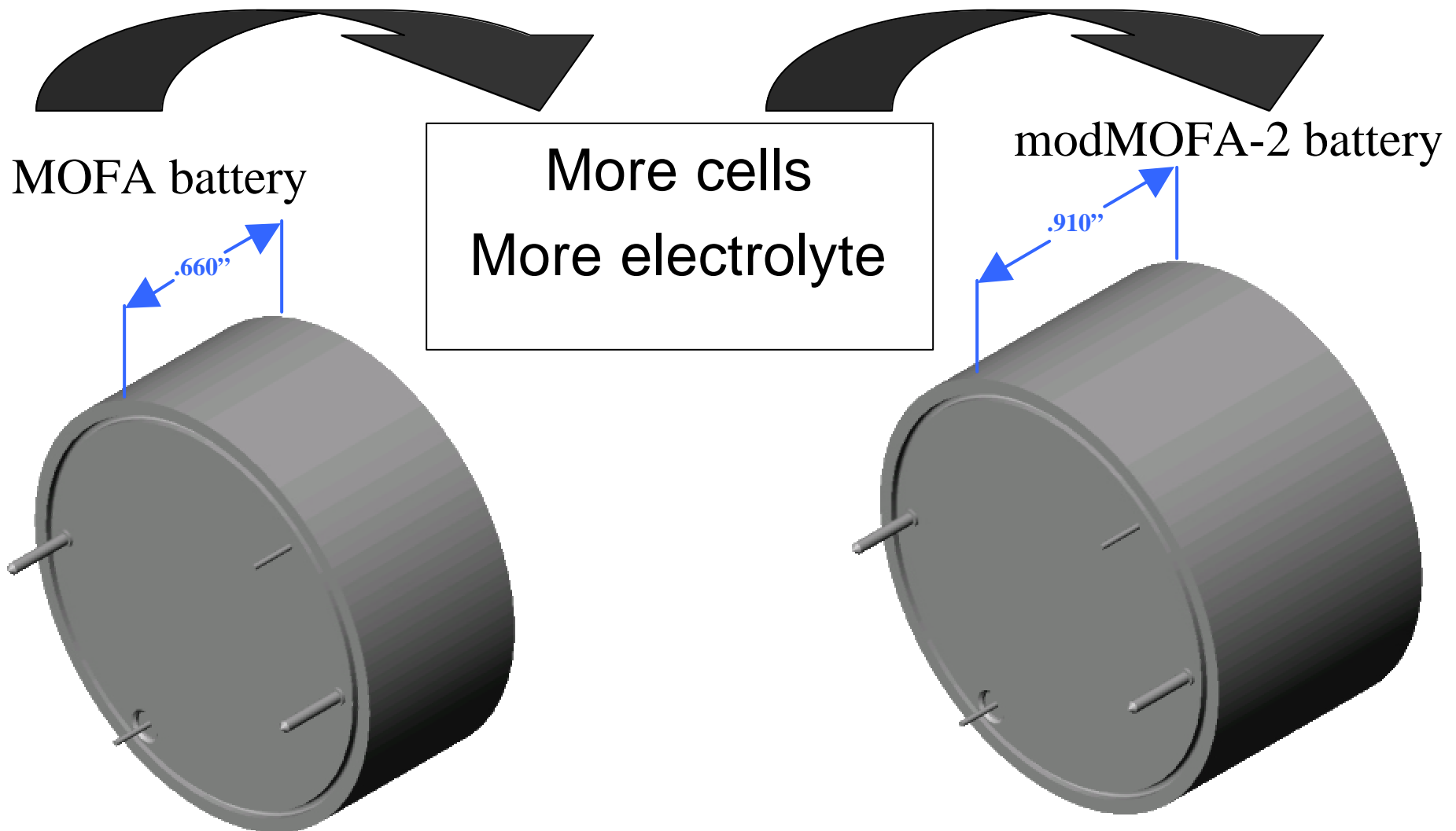
MOFA Post Launch
Battery
5.6-11.76 volts



Lithium-Thionyl
Chloride;
moderate rise time



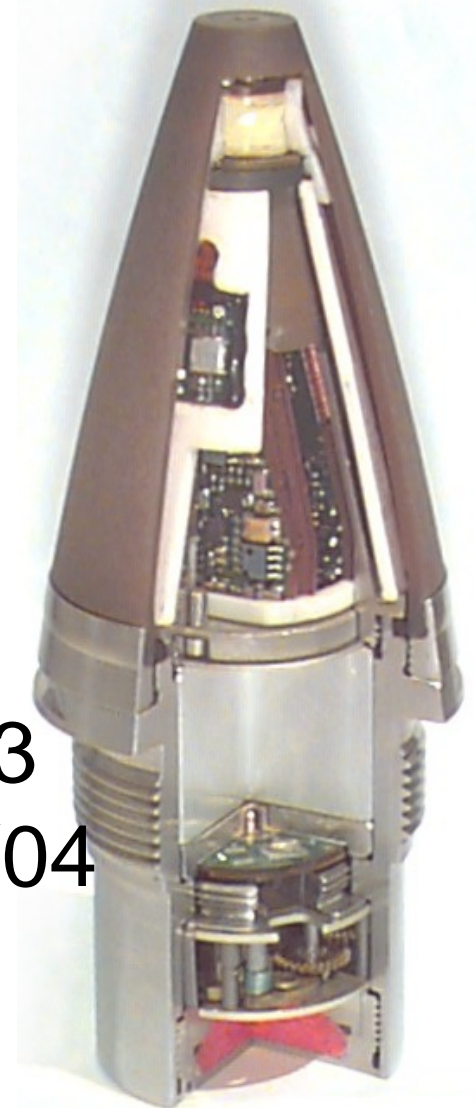
modMOFA-2 Battery





New MFF Battery

- Government-Contractor Team
 - ATK Precision Fuze Company
 - NSWC (Dahlgren & Carderock)
 - ARL (Power Sources Branch)
- Goals
 - Qualified battery design in FY03
 - Certified in MK419 Mod 1 in FY04



NAVAL SEA SYSTEMS COMMAND

ERGM

EX171 EXTENDED RANGE GUIDED MUNITION



NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION

Submunition & Unitary Warhead



DAHLGREN PANAMA CITY DAM NECK



ERGM Submunition Payload



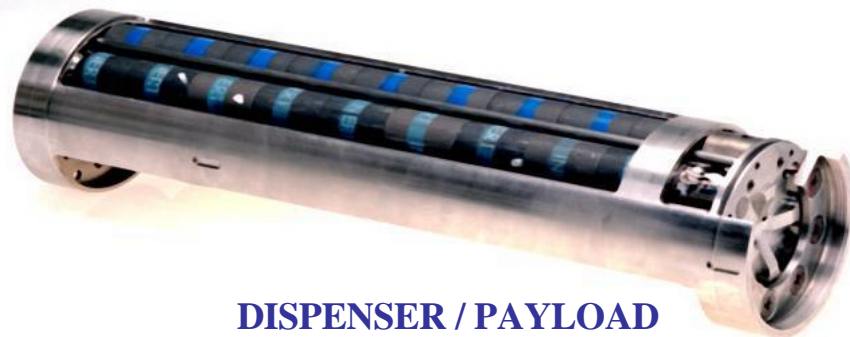
**EX-1
SUBMUNITION**



**NESTED M234
SD FUZE**



EX-87 SAFE & ARM



**DISPENSER / PAYLOAD
ASSEMBLY**



FLIGHT BATTERY



Why Change to Unitary?

- Expected Lethality
- Arming Reliability
- Unexploded Ordnance Requirement
- WSESRB Shipboard Safety Concerns
 - Cargo Safety Program Status
- Facilitization and Production Concerns
- Production Cost



Unitary ERGM Concept

Previous warhead volume (minus 1")
now dedicated to:

- 12" Blast/Frag warhead
 - PBXN-9 explosive
 - Embedded EX87 S&A
- 6" Forward electronics section
 - M734 processor
 - S&A electronics
 - Shorter thermal flight battery



Schedule

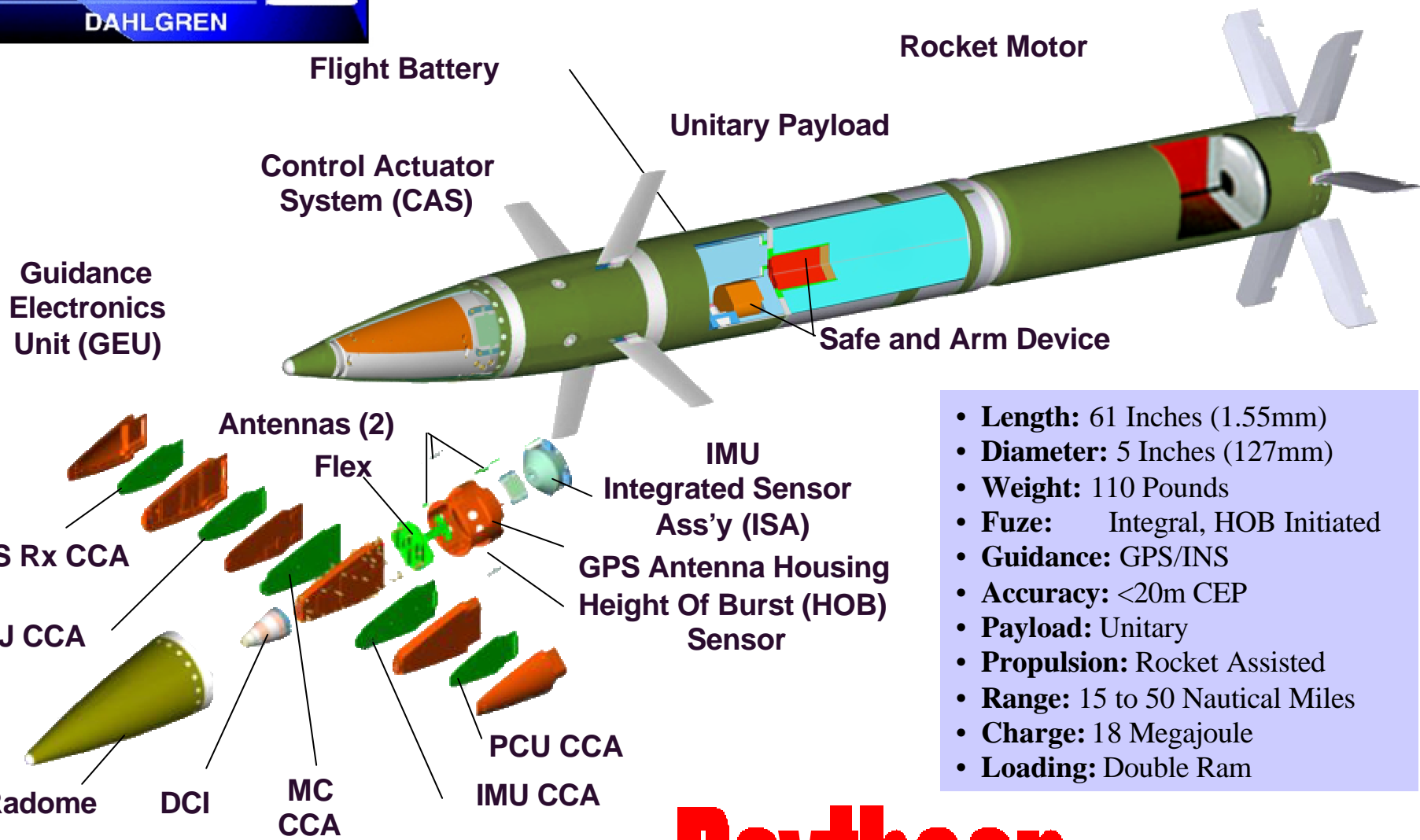
- Unitary Warhead Design – FY '02
- ERGM Qualification Testing – FY '04
- TechEval & OpEval - FY '02

Assumptions:

- Stay Within Funding Limitations
- Unitary PDR End FY '02
- Shortened Flight Battery (Qual Moved to FY '03)
- Rocket Motor Increase 1" for Unitary ERGM



Baseline ERGM Projectile



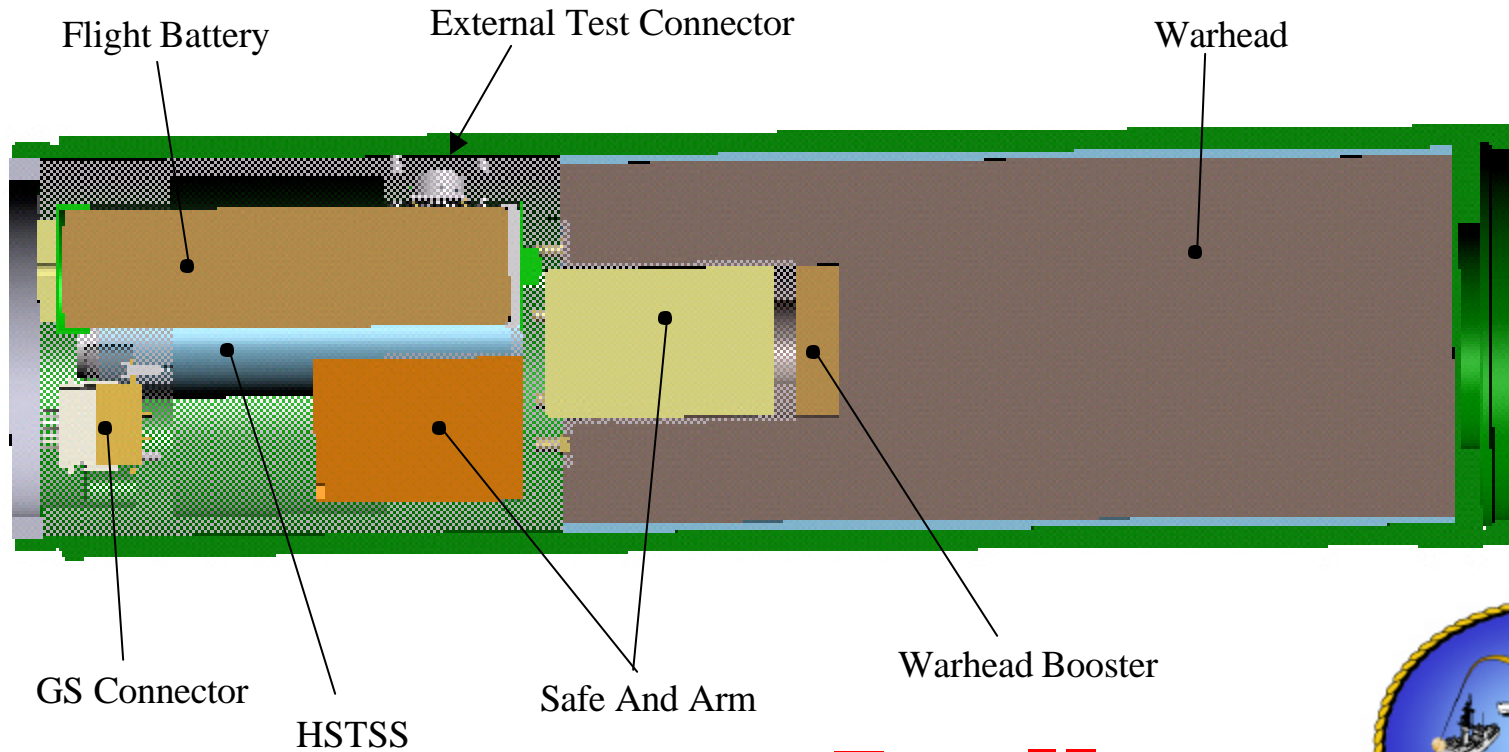
- **Length:** 61 Inches (1.55mm)
- **Diameter:** 5 Inches (127mm)
- **Weight:** 110 Pounds
- **Fuze:** Integral, HOB Initiated
- **Guidance:** GPS/INS
- **Accuracy:** <20m CEP
- **Payload:** Unitary
- **Propulsion:** Rocket Assisted
- **Range:** 15 to 50 Nautical Miles
- **Charge:** 18 Megajoule
- **Loading:** Double Ram

Raytheon



ERGM Unitary Warhead

Cut Away View Of Payload



Raytheon





Program Objectives

- ❑ Develop an alternative Low Cost Guidance Electronics Unit (LCGEU) for ERGM
 - form, fit, & function replacement for ERGM GEU
 - make performance versus affordability trades
 - target u/c of \$7k in FY04 dollars, based on 2000 units
 - **demonstrate** performance via a series of guided flight tests

**LOW
COST
GEU**

*Form, Fit, Function GEU
replacement for EX-171*



DRAPER
LABORATORY



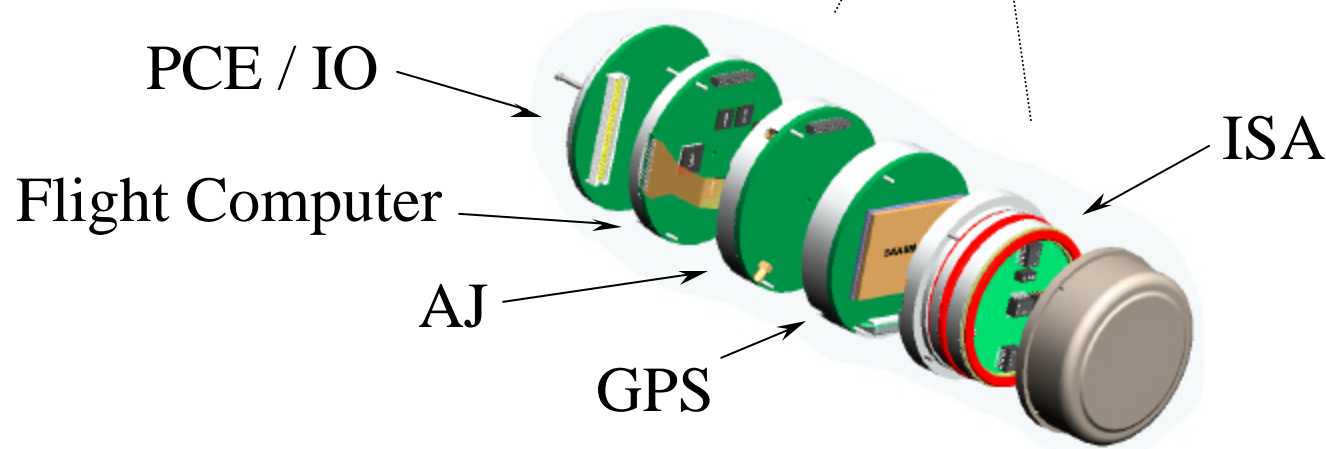
**Rockwell
Collins**

ANC



Mechanical Concept

- Disk configuration.
- Modular
- Designed to Excalibur G-levels
- Packaged for ERGM
- Compatible with rolling airframes





LCGEU Program Plan

- Currently demonstrating gun shock survivability
- First gun launch on ERGM airframe
Fall 02
- Gun testing on ERGM airframe
completed Spring 03